

Project Title: Enabling affordable access to fibre infrastructure for West and Central African higher education institutions

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Abstract:

The project aimed at carrying out two studies to provide research-based evidence of the poor connectivity of West and Central African higher education institutions and to assess the availability of fibre infrastructure in the region. Furthermore, the project intended to use the findings of the studies to raise awareness of policy and decision makers to convince them on the need for urgent measures for improving the situation.

The studies were carried out and the related reports widely disseminated. The Research and Education Networking Unit of the Association of African Universities then organized a high-level awareness conference with Ministers in charge of higher education, Ministers in charge of ICT, Permanent Secretaries, Vice-Chancellors, Representatives of the African Union Commission, Telecommunication Regulators and Development Partners among the participants.

The conference was preceded more than one year earlier by a workshop that brought together close collaborators of Ministers in charge of higher education and ICT and other stakeholders, in order to brief them on the findings of the studies, which reports have been published and widely disseminated.

A major outcome of the project is that the need to pay more attention for the improvement of the connectivity of higher education and research institutions have been acknowledged and recognized by many high-rank policy and decision makers of the region; furthermore, supporting the establishment of national research and education networks (NRENs) is now on the agenda of these policy and decision makers, as shown by increased requests to the AAU to facilitate this process and by the presence of Ministers and other high-rank policy and decision makers in the related activities.

The project had also a positive impact on the establishment process of WACREN, the West and Central African Research and Education Network, which was incorporated in August 2010 and got its first elected Board on March 2011.

Keywords: Research and education networks, connectivity, fibre infrastructure, higher education.

1. Rationale

In 2006, the International Development Research Centre (IDRC) participated in funding the establishment of a Research and Education Networking Unit at the Association of African Universities (AAU).

The role of the Unit is to establish a platform for collaboration among African higher education and research institutions and with their pairs outside the continent on issues related to connectivity, access to bandwidth at affordable cost, ICT policy and capacity building, among others.

In the framework of its activities, and recognizing the fact that West and Central Africa is lagging behind other regions of the continent in the process of establishing research and education networks (REN), the AAU developed and submitted to IDRC the project “Enabling affordable access to fibre infrastructure for West and Central African higher education institutions”. Subsequently, IDRC approved a grant of 467,500 US\$ for the implementation of the project.

2. Objectives

As stated in the project proposal, the general objective of this project is to enable the provision of affordable bandwidth for African HEIs in West and Central Africa through sensitisation and lobbying at highest levels supported by research findings and benchmarking.

The specific objectives are the following:

- To compile key facts on the state of connectivity in West and Central African HEIs¹ and to compare that connectivity with those of HEIs in other parts of the world (Europe, North America, Asia and Latin America);
- To investigate on available dark fibre in West and Central Africa and to assess the regulatory arrangements for accessing unused capacity;
- To raise awareness of high-level policy and decision-makers on the necessity for special measures aiming to facilitate access to more and cheaper bandwidth for African HEIs.

3. Methodology

The research activities that were conducted were based on data collected through surveys realised with a sample of HEIs in West and Central Africa. The survey approach using questionnaires has proven to be very efficient in previous researches on connectivity in Africa. Follow-ups and collection of complements of information can be done through email, phone interviews and field visits where necessary.

The surveys were realised using appropriate questionnaires distributed to ICT/network managers of HEIs of the targeted countries and to other relevant stakeholders.

The research on HEIs’ connectivity focused on a representative set of selected countries in West and Central Africa, namely Burkina Faso, Cameroon, Côte d’Ivoire, Ghana, Liberia, Mali, Mauretania, Nigeria and Senegal. These countries (except Liberia, Mauretania and the

¹ This work will draw upon the data from the 2006 ATICS report that can be refined for the region of concern for this project.

land-locked Burkina Faso and Mali) are SAT 3 landing point countries. Due to the prominent role of many of these countries in the fields of higher education and telecommunications in West and Central Africa, it can be expected that the research findings will give a global picture of the whole region. It is also to mention that NREN establishment processes have started in many of these countries, with different levels of progress.

While the research team focused on the above listed countries where data gathering through questionnaires and interviews were carried out in an important number of HEIs (51), questionnaires will be sent later to all countries of the region. This will allow to better cover the region, as in the ATICS research 20% of the surveyed institutions were located in West Africa, but only 5% from Central Africa, probably due to low response rate. Additionally, the higher education landscape has significantly changed in many countries of the region as many public and private institutions were created in the recent years.

It was planned to organise a facilitated methodology workshop for this research component in order to validate the methodology and the instruments to be used to ensure easy integration of country research results. However, due to time constraint, this workshop was not organised and the methodology was developed, discussed and validated online.

The research component on available dark fibre infrastructure in the region, the capacity of this infrastructure and access conditions required not only desktop research, but also field trips in the targeted countries for face-to-face interviews with concerned stakeholders (infrastructure owners, regulatory authorities, representatives of HEIs). These field visits were also used as support for follow-up on the data collection process (survey questionnaires) in order to maximise the number of respondents. Field visits were carried out only in countries where evidence of existence of substantial dark fibre infrastructure has been found through desk research and other means (interviews, queries through emails, etc.).

Researchers residing in the targeted countries carried out the connectivity survey research component; this eased the data collection process. A team leader coordinated the work of the research team while having in charge the collection and analysis of the data on HEIs' connectivity outside Africa needed for the benchmarking.

Two researchers carried out the dark fibre study for West and Central Africa.

4. Project Activities

The activities of the project can be grouped in the following categories: connectivity study, fibre study, pre-conference workshop, awareness conference and publications.

4.1. HEIs' connectivity in West and Central Africa and benchmarking

4.1.1. Objectives of the study and methodology

The purpose of this research was to compile data on HEIs' connectivity in West and Central Africa, and to compare them with HEI's connectivity available in other parts of the world. The research also determined the actual bandwidth/user available for students and academic staff and the minimum necessary ratio for performance-leading work and learning conditions.

The work on this research drew upon the data and findings of the African Tertiary Institutions Connectivity Survey (ATICS) supported by the IDRC, by updating and completing the available data. The research also looked at relevant issues that were not addressed by ATICS, e.g. minimum bandwidth requirements for typical educational and research applications, benchmarking for bandwidth access (comparison of bandwidth per

user and computer in African HEIs and in HEIs in other parts of the world), correlation between regulatory environment and bandwidth accessibility, budgetary issues, etc.

Main components of the research activities were the gathering of actual facts on the state of connectivity in West and Central Africa with emphasis on available commercial fibre infrastructure and assessment on the regulatory environment, as well as the price levels and structures. These data were compared with those available for other parts of the world, in order to show the existing discrepancies between the working conditions of African researchers, academic staff and students with those of the rest of the world they are supposed to compete with in the context of a global knowledge economy.

It was planned to organise a methodology workshop in order to allow the research team to get together to discuss, refine and validate the proposed methodology. However, due to time constraints, this workshop was not organised and the methodology was developed, discussed and validated by the research team online.

4.1.2. Key findings and recommendations

The key findings of the study are as follows:

- If the cost of bandwidth decreased to what HEIs in the US and OECD countries pay for their connectivity, then West and Central African HEIs would with the same budget that they currently have be able to afford to buy enough bandwidth to meet their requirements over the next five years.
- Reducing the cost of bandwidth can be achieved by acting in consortium to achieve bulk discounts, but cannot go below US\$2.33 using existing satellite technology, and opportunity created by the submarine cables in West Africa and dark fibre regional transmission network. [in fact, as the map shows % of HEIs could be directly connected to sub cables, leaving bandwidth by satellite].
- The AAU Connectivity survey was conducted during June 2008, from a total of 51 Higher Education Institutions (HEIs) in the nine West African countries of Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Liberia, Mali, Mauritania, Nigeria and Senegal. Compared to the ATICS survey conducted in 2004, this represented 43.6% of all known institutions in these countries (117), and 32 % of the total estimated population of all staff and students in tertiary institutions in West and Central Africa. The survey was conducted by team of researchers in six countries posing the questionnaire to the IT staff responsible for the provision of at each HEI.
- The 51 HEIs together represented a total population of 712,763, comprising of 17,374 members of staff, 638,008 full time students and 57,381 part time students. These current students represent the next generation of Internet users, which are entering the labour market each year. Staff are engaged in teaching and research activities.
- The total bandwidth of these 51 institutions was 73.690 Mbps (downlink) and 41.834 Mbps (uplink) in 2008, a total of 115.524 Mbps. The HEI's with the highest bandwidth were the University of Ibadan (Nigeria) with 10.392 Mbps (downlink), Kwame Nkrumah University of Science and Technology (Ghana) with 9 Mbps (downlink) and the University of Ghana (Legon) with 7.168 Mbps (downlink), followed by Ahmadu

Bello University Zaria (Nigeria) with 5 Mbps (downlink) and UCAD and UGBSTL in Senegal with 4.096 Mbps (downlink). One HEI, the Sa'Adatu Rimi College of Education (Nigeria) had one single computer connected to the Internet with one dial-up link of 56 Kbps, for a student population of 21,000 and 320 members of teaching and research staff.

- If the average bandwidth per HEI population of the nine countries surveyed is applied to the wider region, this would give a total estimated current bandwidth for the 22 countries of the West and Central Africa regions of 266.261 Mbps (downlink) and 109.614 Mbps (uplink), a total of 375.875 Mbps.
- HEIs were asked to estimate the minimum actual bandwidth that the institution required, unrestrained by price. This will therefore provide an approximation of current unaddressed latent demand. The total was [328.78] Mbps (downlink) and [168.83] Mbps (uplink), a total of [497.61] Mbps or 4.3 times the current bandwidth. Three institutions believed that their current bandwidth was sufficient to meet their minimum needs: Institut Supérieur d'Informatique et de Gestion (Burkina Faso), Kumasi Polytechnic (Ghana), and University of Ibadan (Nigeria). Eight believed that current bandwidth only met 50% of their actual minimum requirement, five that it only met 25% of their actual requirement, and 14 that their current bandwidth was less than 25% of their actual current requirement.
- If the average required bandwidth per country for each of the nine surveyed countries was applied to the remaining institutions in that country (based on total HEI population), this would give a total current required bandwidth of 965.301 Mbps (downlink) and 320.231 Mbps (uplink), a total of 1,285.533 Mbps.
- The future bandwidth requirement estimated by HEIs would therefore have to increase 4.31 times in order just to meet the current minimum requirement [328.78] Mbps (downlink) and [168.83] Mbps (uplink), eight times to reach the estimated requirement of [603,367] Mbps (downlink) and [312.228 Mbps] (uplink) within two years by 2010, and fifteen times to reach the estimated requirement of [1,156.356] Mbps (downlink) and [593.513] Mbps (uplink) within five years by 2013.
- The amount spent on bandwidth was [US\$1,688,245] per year in 2008 (data from 37 HEIs). This was up from [US\$1,102,637] per year in 2007 (34 HEIs), [US\$811,592] in 2006 (25 HEIs), and [US\$494,738] in 2005 (17 HEIs). The cumulative spend over the last four years was [US\$4.007 million]. Based on the amount paid by each institution for their bandwidth, without bulk discounts this would reach [~ US\$7.5] million in order to satisfy current requirements. At current pricing, without bulk discounts the total budget to meet this requirement would reach [US\$13.8] million by 2010 and [US\$26.5] million by 2013. The cumulative spend over the next five years from 2008 – 2013 to meet the actual estimated requirement would be [US\$98.8 million].
- All 51 HEIs indicated that they would be willing to participate in a bandwidth buying consortium.

Recommendations

This study shows that the HEIs in Western and Central Africa represent a total user base of over 100 institutions and 2.16 million users, representing an estimated total bandwidth in 2008 of 266 Mbps and a budget of US\$9.5 million.

By acting collectively, though HEIs building National Research and Education Networks (NRENS), and NRENS building a Regional Research and Education Network (RREN), HEIs will be in a much better position to take advantage of the new submarine cable and regional fibre optic networks which are becoming available. The pricing becoming available on these competing systems is far below what was possible using satellite alone, and will enable HEIs to meet their own requirements and relative to HEIs elsewhere in the world.

In addition, a West and Central African bandwidth consortium, or Regional Research and Education Network (RREN), would be in a position to *peer* with the European Géant2 academic network. Under a peering arrangement, both parties pay half the cost of the circuit, rather than one party bearing the full cost. Such an agreement would halve the cost again, as each party would pay for their half of the circuit.

Géant2 has likewise established reciprocal arrangements with other regional academic networks including EUMEDCONNECT, ALICE, and TEIN2. Through Géant2 therefore, the bandwidth consortium would have access not only to NRENS and HEIs and in Europe but also to counterparts in North Africa, Latin America, Asia and the US.

4.2. Fibre study

4.2.1. Objectives of the study and methodology

The purpose of the dark fibre study was to complement the dark fibre study carried out by SARUA with support of IDRC that focused on Eastern and Southern Africa; thus, the study carried out in this project was to allow having a more comprehensive picture on available dark fibre in Africa.

This is of particular interest for African HEIs in the context of concentration of satellite bandwidth providers that encourages monopolistic price structure for this service that could be seen as alternative to the expensive commercial fibre. During 2006, two major satellite operators acquisitions were noted: Intelsat acquired PanAmSat, thus operating now 25 out of the 54 satellites over Africa, and SES Global acquired New Skies Satellites, thus owning 6 out of 54 satellites over Africa². Therefore, more 50% of the satellites providing bandwidth on the continent are in the hand of 2 operators only. Unfortunately, the hope for a short-term decrease of satellite bandwidth price through availability of more bandwidth disappeared with the explosion of the rocket carrying the NSS 8 satellite during its launch in 2007³.

The research team was asked to make an inventory of available fibre in West and Central Africa accessible through telecommunications companies, record their capacity and assess their conditions of use as well as the amount of unused capacity. The assessment of access conditions could be drawn from existing research findings on regulatory environment in

² See <http://www.developingtelecoms.com/content/view/540/59/>

³ See <http://www.spaceflightnow.com/sealaunch/nss8/>

Africa⁴ and refined through interviews carried out during the field visits. Data on available dark fibre in the region with emphasis on the land-locked countries were also gathered and the conditions of access to the unused capacity of this infrastructure investigated.

To compare with the prevailing situation outside Africa, information on access policies to dark fibre in other parts of the world were gathered, with emphasis on access policies for educational institutions, where such arrangements exist. Finally, the impact of favourable access policies to dark fibre for the improvement of research and learning activities were evaluated and documented.

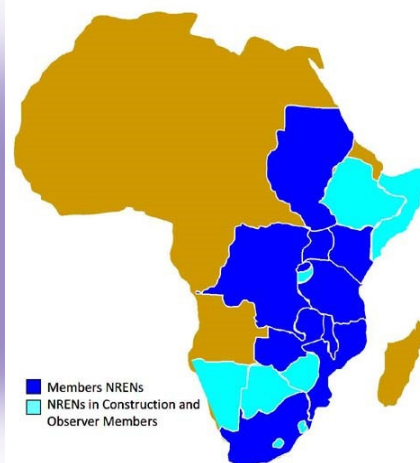
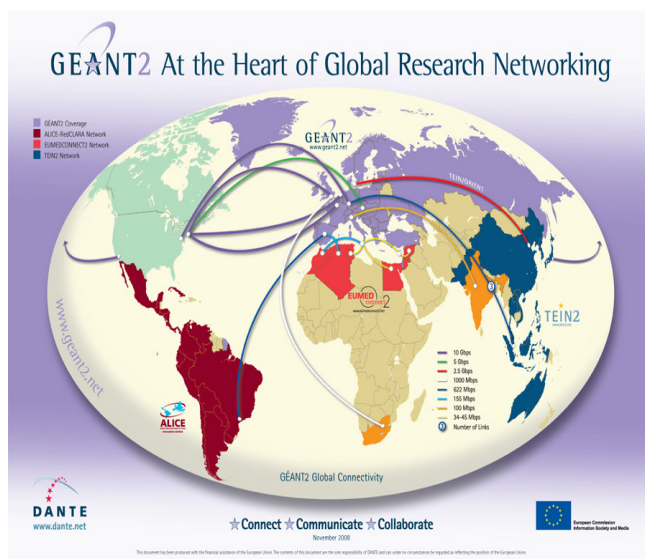
4.2.2. Key findings and recommendations

With few exceptions, African universities lack access to the same resources for research and education as their peers on other continents. This is simply due to the fact that they are not connected to the global research and higher education infrastructure consisting of high capacity regional networks such as GEANT in Europe, providing transit to TEIN in Asia, RedCLARA/ALICE in South America as well as to INTERNET2 and CANARIE in North America (www.dante.net), the Global Lambda Interchange Facility (www.glif.is), etc.

This means that research and higher education requiring such access, constituting a significant part of the global research and higher education activities, can currently not be conducted in Africa.

This is not just a matter of improving the connectivity to Internet in general. Transit to Internet is not enough. It is mainly about peering with other research and higher education networks by creating dedicated National Research and Education Networks (NRENs) connecting research and tertiary level education institutions in each African country to a Regional Research and Education Networks (RREN) interconnected to the above mentioned infrastructures on other continents.

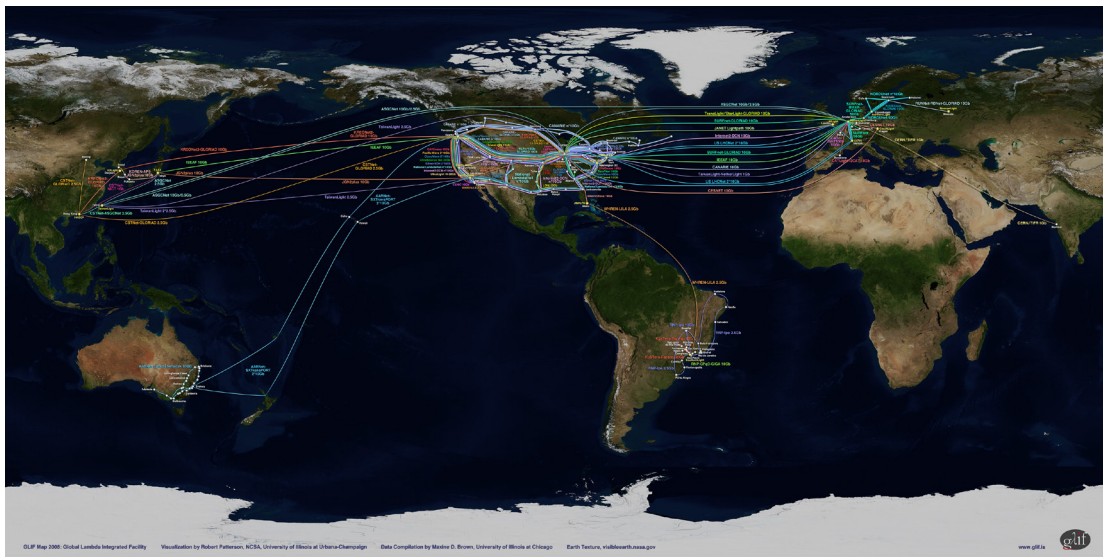
At the same price as African universities currently pay for VSAT transit links to Internet only, with low bandwidth and high delay, universities on other continents get dedicated networks with up to 100000 times higher bandwidth, much lower delay and **both** transit to Internet in general via commercial transit **and** peering with the dedicated networks established by the global research and higher education community.



⁴ Research carried out by Research ICT Africa – RIA (<http://www.researchictafrica.net/>), the Association for Progressive Communications (<http://www.apc.org/>) and other organisations.

ABOVE: The regional research and higher education network in Europe, GÉANT (left), to which all European national Research and Education Networks are connected, provides global links interconnecting all regional research and education networks, including TEIN in Asia, RedCLARA in South America via ALICE and North Africa via EUMEDNET, as well as to INTERNET2 and CANARIE in North America. GÉANT is operated by DANTE (www.dante.net). So far, only a few members in the emerging Ubutunet in Africa (right) are connected via the SAT-3 link to the Ubutunet hub in London or, in the case of Kenya, via a tunnel through the KENET commercial VSAT provider. More Ubutunet members will become connected during 2009. It is important to get West & Central Africa moving rapidly in this direction as well. (Sources: DANTE and Ubutunet Alliance)

BELOW: the Global Lambda Interchange Facility (www.glif.is) does not yet touch Africa. Only political awareness and will to act on the policy level can change this. (Source: GLIF)



Stakeholder analysis overview - Political awareness and will?

All interviewed stakeholders have demonstrated a positive attitude towards the needs of research and higher level education institutions, including policy-makers in research and higher education as well as in the communication sector, regulators, fibre owners and telecommunication service providers.

The researchers sense, however, that there might exist blocking stakeholders, both among government agencies and among incumbent operators, due to lack of understanding of the importance and nature of RENs or due to perceived or real conflicts of interest.

The difference between Internet access and access to the Global Research and Education infrastructure mentioned above is poorly understood among policy-makers and regulators. The same goes for the understanding that the future requirements of research and higher education institutions are orders of magnitude greater than that of others and cannot be met by bundling them with other public or private user groups. Since the researchers' questions thus might have been interpreted differently by different people, some of the responses received may have to be interpreted in different contexts.

It is also important to understand that there is a drastic shift involved in all dimensions going from simple low-capacity transit to the Internet using individual VSATs at each institution, to a joint national high-capacity multi-homed network environment with equal shares of academic peering and Internet transit, requiring institutional cooperation on all levels, nationally and regionally.

On other continents, research and higher education institutions are recognized as closed user groups with needs calling for dedicated networks. These institutions are not only capable of building, operating and managing their own networks, but also developing them further, and can thus take advantage of access to more basic infrastructure resources than normal user groups. As a consequence, most NRENS in Europe and North America have opted for access to dark fibre or wavelengths, since such resources are available on reasonable terms on their markets. Standard backbones currently in operation consist of one or more 10 Gbps Ethernet links, often independently routed in ring structures to maximize availability.

Since these networks are strictly non-commercial and only used by a closed user group, they constitute no threat to the commercial market. Instead, they drive the demand for more capacity in commercial applications by training staff and developing applications that migrate into the commercial world.

The regulatory environment seems to be permissive

Our discussions with regulators seem to suggest that neither national nor regional RENs need special licenses, at least not in most ECOWAS member states, provided they are dedicated to research and higher education, strictly non-commercial and lease optical fibre and other network elements from licensed fibre owners. Before the licensing conditions can be analyzed in detail and decided by the national regulators, the RENs need to get organized and have well prepared development plans. The structure of the NREN must be tuned to fit the legal environment and the users nationally, but at the same time fit the international research and education networking community with their demands on Acceptable Use Policy etc.

The issues involved in cross border transit are currently discussed among policy-makers, regulators, operators, donors and financial institutions.

The necessary physical infrastructure is already available in terms of optical fibre

Physical infrastructure is not a backbone bottleneck. Our study shows that there is already optical fibre available within and between most countries in West and Central Africa to connect most of the key research and higher education institutions and to interconnect them to other continents. Significantly more fibre infrastructure is not only being planned and discussed but also being rolled out. The fibre maps are changing rapidly.

Infrastructure in terms of optical fibre is already available to build a regional as well as national research and education networks with reasonable coverage of institutions in the region, except in a few countries that are however covered in plans under discussion. The latter category includes the Gambia, Guinea-Bissau, Guinea, Liberia.

The conditions for access to fibre needs to be negotiated

The conditions under which access to the available fibre can be granted needs to be carefully negotiated with the fibre owners. Some of the fibre providers approached in the study, especially new entrants as fibre owners and broadband service providers, have declared an interest in discussing win-win agreements with RENs about granting access to basic infrastructure resources that may not be made generally available on the commercial market, provided that the universities prove competent to establish and manage their own networks.

The expected return, in addition to early revenues not removing future commercial market but favourably impacting return on investments and payback time on the fibre investment is market development with socio-economic impact in terms of strictly non-commercial research, education and outreach activities from the universities. Before such negotiations can start, the RENs need to get organized, be able to communicate a clear strategy and vision, and have reasonably well prepared development plans. It is important to not forget a

communication strategy relating to the needs and sensitivities of external parties like fibre providers.

Maturity of the REN formation processes is the first main bottleneck

There seems to be an awareness and interest among research and education institutions to establish NRENs in most countries included in the study. The concept of an RREN seems also to be reasonably well understood, although there is little experience with regard to how to make the shift from operation of simple low-capacity transit to the Internet in general using individual VSATs at each institution, to a national high-capacity multi-homed network environment with equal shares of academic peering and Internet transit, requiring institutional cooperation on all levels.

In the countries the researchers looked into, via physical visits or discussions over phone and email, we have seen some of the necessary activities in progress. They have not, however, been able to see documented plans discussing strategic issues, such as visions, policy issues, relations to other African subregions, including EUMEDNET and Ubuntunet, fund raising strategies, national and regional coordination, or project plans with goals, objectives, work break-down into activities, resource requirements, organisation, capacity building plans, stakeholder analyses, fund raising strategies, risk analyses, etc.

So far no formal RREN or NREN organisation is to be found in any country, although there are some processes under way. The champions of these processes need to be identified and supported through the first formation steps. There seems to be no potential NREN member institution that has submitted an application to AfriNIC for the assigned numbers (AS-number and IP address space) necessary to be able to peer with peer institutions on other continents. As bases for such applications it is necessary to map the topology and make an inventory of hosts down to the individual campus network level.

All the REN processes would benefit from guidance for how to establish RENs and coaching in the process. The researchers provided a brief check-list including creating legal bodies, making the abstract design of the networks necessary to apply for assigned numbers from AfriNIC and to discuss licensing requirements with the policy-makers and national regulators, refining the network design to prepare negotiations with infrastructure owners and make requirement specifications for equipment to be procured, formulating Acceptable Use Policies, including enforcement procedures and sanctions, defining the organisation for Network Operation Centres (NOC), including tools and working procedures, defining the need for capacity building of human resources, etc.

To kick-start, the NREN communities in West and Central Africa should open talks with colleagues involved in other African sub-regional efforts, such as EUMEDNET and Ubuntunet Alliance, as well as in NRENs in other regional networks in Europe and the Americas. Lots of basic structure can easily be drawn from prior work. Significant time can probably be saved by cutting and pasting after some initial awareness raising making the NREN officials, interim or not, understand why the documents are looking the way they do.

Another consideration is the differences in perspective on who may control or own this NREN formation process: Is this a bottom up activity owned and driven by cooperation between individuals engaged in campus connectivity, or is it a top down activity with initiatives expected from ministry level? In an environment where capacity is scarce and top down is the general norm, it is perhaps difficult to initially expect a lot of the local engagement that NRENs elsewhere thrive from. Any early NREN process needs at least a benevolent recognition from the top, not adding policy uncertainty to all other difficulties.

Formation of National Research and Education Networks (NRENs)

On the national level, there are very different scaling challenges. Benin, Burkina Faso, Ivory Coast, Mali, Niger and Togo have about a handful of institutions each, while Ghana has up to a 100 and Nigeria has up to 500 eligible institutions, including both public and private. This calls for coaching of the processes in homogeneous subgroups.

Formation of Regional Research and Education Networks (RRENs)

On the regional level, there is a clear lack of communication between NREN communities in different countries. In several cases, the involved people have never met or even heard about each other. In our opinion the regional process should not wait for the NRENs to materialize, but be established in parallel since there will be considerable cross-stimulation. An RREN Task Force should be kicked-off as soon as possible.

Recommendations

To summarize, the conclusion from the AAU fibre study is that the physical infrastructure is available and the universities need to organize and explore to what degree the hurdles discussed above are real in each specific country and how they can be overcome. There is no alternative; the hurdles have to be passed in order to give the West and Central African universities access to similar resources as their peers in other regions.

4.3. Pre-Conference Workshop

4.3.1. Objectives

Prior to the organisation of the “Awareness Conference”, an experts meeting was held in Dakar on June 2009. Ministers and other high-level policy and decision-makers are generally very difficult to mobilize over a long period of time for international meetings. Therefore, the conference was organised over 2 days (18-19 October 2010). As it is not realistic to draft, discuss and adopt a position paper within 2 days, a pre-conference workshop was organised in Dakar. The workshop brought together advisers/collaborators of ministers, heads of regulatory authorities and vice-chancellors of selected countries.

Main objectives of the workshop were to discuss the research findings, elements of the declaration to be adopted at the conference and to set up a preparatory committee of the conference.

The workshop was crucial as the selected participants were in a position to brief their ministers/heads on the issues and on the importance of the conference months before it's held.

The main outcome of the meeting was that participating advisers/collaborators of Ministers and other policy/decision makers have been put in a position to explain to the ministers, heads of regulatory authorities and vice-chancellors the stakes of the conference, with more chance to have them adhere to and advocate for the ideas developed in the declaration that was later adopted on 19 October 2010.

4.3.2. Workshop report

4.3.2.1. Introduction

The Workshop was held at Hôtel des Almadies in Dakar on 22-23 June 2009. Two participants each representing the ministries in charge of higher education and information

and communication technologies of Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Mali, Nigeria and Senegal attended the workshop. Participants (30 in total) also included representatives of the AAU, IDRC and consultants.

The purpose of the Workshop was to:

- Present the findings of the study on “Demand for Connectivity of Higher Education Institutions (HEIs) in the West and Central Africa Region”
- Present the findings of the study on “Connecting West and Central Africa to the Global Research and Education Infrastructure
- Exchange ideas with regards to the development of National Research and Education Networks (NRENs) in West and Central Africa region
- Prepare ground for the holding of a high level meeting of Ministers of Higher Education and Information Communication from the West and Central Africa to be held in October 2009.

4.3.2.2. Opening

The Workshop was opened by Mr. Alioune Camara, representing the International Development Research Centre. Mr. Camara noted that the IDRC has been supporting the development of National Research and Education Network (NRENs) throughout Africa. Progress was made in the consolidation of Regional Research and Education Networks in eastern and southern Africa over the last five years. The West and Central Africa is lagging behind.

Mr. Camara noted that the IDRC has funded the studies on demand and supply for connectivity for higher education in West and Central Africa in order to provide evidence for decision makers and facilitate the creation of National and Regional Research and Education Networks. He urged the participants to comment on the documents, support the establishment of sustainable National Research and Education Networks and assist the ministers in participating in the October meeting.

Dr. Boubakar Barry, the Coordinator of Research and Education Networking Unit (RENU) of the Association of African Universities noted that the AAU has been actively engaged in the development of national and regional research and education networks. Following a mandate given by the 11th General Conference of the AAU held in Cape Town in February 2005, the AAU assumed more coordinating role of many ICT initiatives in African Universities. In December 2005, the AAU convened and IDRC-supported Conference on African Research and Network Infrastructure to build on the results of earlier events and shape them into an action plan to be implemented under African leadership. Since then the AAU:

- Established a Research and Education Networking Unit that acts as a focal point in relation to the many ICT initiatives in African universities and the development of national and regional research and education and networking. The Unit promotes collective action, especially in relation to increased access to cheaper connectivity and develop a “clearinghouse” of information on ICT and research and education networking initiatives, trends, opportunities, good practices, expertise and funding

sources. RENU is at the forefront of the development of national and regional research and education networks.

- Signed Memorandum of Understanding (MoU) with pan-African entities the African Internet Registry (AfriNIC Ltd) and the African Network Operator Group (AfNOG) with the aim to provide universities easy access to Internet addresses and networking skills.

Dr. Barry noted that AAU is a key partner in the development of research and education networks in West and Central Africa. The meeting is a step towards to achieve regional networks. He urged the participants to:

- Thoroughly review and discuss the studies on demand and supply of connectivity to National and Regional Research and Education Networks in Western and Central Africa
- Exchange ideas on how to put in place and promote National Research and Education Networks
- Devise strategies for the organization of a high level of policy makers (Ministerial) conference in October 2009.

The opening of the workshop was followed by presentation of the studies and discussions.

4.3.2.3. Survey of Demand for Connectivity of Higher Education Institutions (HEIs) in the West and Central Africa Region – By Paul Hamilton

The Association of African Universities (AAU) Connectivity survey was conducted during June 2008, from a total of 51 Higher Education Institutions (HEIs) in the nine West and Central African countries of Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Liberia, Mali, Mauritania, Nigeria and Senegal. The 2.2 million staff and students in the region have on average on 0.37 Kbps per head (which is reduced to 0.10 Kbps of raw bandwidth once the exaggerating effect of broadband services is removed). Under current procurement arrangements, HEIs will fall further behind their own estimated bandwidth requirements of about 3Gbps by 2013. Half of the universities are covered by satellite although fiber is currently available to over 95% of the universities.

The study found out that the universities pay around US\$2300 per Mbps/month and currently pay around US\$30 million for connectivity. The expense is estimated to over US\$100 million if the current pricing for connectivity holds. There are two options for the research and academic institutions to increase their bandwidth to a more desirable level: either increase the budget in order to buy more bandwidth, or find ways of negotiating better price to buy more bandwidth with the same budget.

The study argued that it is extremely unlikely that West and Central African universities will be able to afford to increase their budget to some US\$100 million over the next five years in order to meet the estimated cumulative demand. Even within a bandwidth buying consortium negotiating bulk discounts on satellite bandwidth, they would still fall considerably short of the bandwidth they require. For this reason, the option of negotiating price reduction is preferable.

Discussions that followed the presentation focused on the following issues:

- The projected bandwidth in the demand study will not be sufficient for academic institutions. African academic and research institutions should strive to obtain bandwidth comparable to their peers in America, Asia and Europe. Universities should aim for bandwidth between .3 to .5 Gbps in the long run.
- It is important to work closely with the African Union Authority, the Economic Community for West African States, the Economic and Monetary Union for West Africa (UMEOA) and the Economic Community for Central African States to improve the participation of decision makers in NREN activities.
- There is a substantial lack of awareness by the policy makers of the demand and supply of connectivity and the policy, regulatory and financial challenges facing academic and research institutions. A tutorial needs to be organized for the ministers during the conference in October.
- The research and academic community needs to link to its peers (other academic networks) and to the commercial traffic. Access to commercial traffic through local Internet Exchange Points (IXPs) is important to reduce costs and increase access to the global information resources.
- National Research and Education Networks could provide support to secondary institutions. However, the focus of academic connectivity should be on tertiary institutions.
- Financing connectivity remains one of the challenges. There are three main sources of NREN funding: government, donors and NREN member contributions. Experience shows that NRENs need to mix central government and donor funding and membership fees based on circumstances and capacity of the institutions to pay for services.
 - Government funding is usually provided through one or more ministries, departments or other such bodies responsible for education, science, technology, telecommunications or research.
 - Donor funding includes support from bi-lateral and multi-lateral development organization, public and private foundations. Non Governmental Organizations (NGOs) and private industry are also becoming important source of funding. Government and donor funding is critical in the initial phase of establishing the NREN and acquiring the physical network. After the initial phase, funding is also required to continuously upgrade and extend the physical network and to develop new services.
 - Member fees, on the other hand, are essential for running and sustaining the NREN. These fees come in the form of annual contributions or “membership fees” and payments for services such as training and consulting and usually come from the institution’s own budgets.

- On the other hand rather than increasing their expenses NRENs should strive for the reduction of network access tariffs to continue to pay same amount for more bandwidth by intervening into the supply chain of broadband networks.
- NRENs should also need to explore the use of universal access funding to pay for network equipment and connectivity at the inception.

4.3.2.4. Study on Supply of network infrastructure for Connecting West and Central Africa to the Global Research and Education Infrastructure – by Bjorn Pehrson

The report on the supply of fiber connectivity in West Africa noted that National Research and Education Networking is about peering with other research and higher education institutions via links to regional and global networks. With few exceptions, African universities lack access to the same resources for research and education as their peers on other continents, simply because they are not connected to the global research and higher education infrastructure consisting of high capacity regional networks such as GÉANT in Europe, providing transit to TEIN in Asia, Red CLARA in South America as well as to INTERNET2 and CANARIE in North America.

The study showed that there is a substantial amount of fiber that is available to academic institutions in West and Central Africa and more fiber is currently being planned and rolled out. However the policy and regulatory frameworks of the communications market is not adapted to facilitate the development of NRENs. The market is still a high price-low volume one and there is limited competition for supply of Internet and telecommunication services. Major challenges facing academic and research institutions in West and Central Africa pertain to readiness in particular to:

- Ensuring that a continuous supply of competent human resources in the area of internetworking technology is available to design, develop and manage National Research and Education Networks.
- Securing assigned numbers from AfriNIC (AS-number and IP-address spaces)
- Regional cooperation and coordination in particular the evolution of a West and Central African Research and Education Network (WACREN)

A presentation on policy and regulatory perspectives that was made by Anders Comstedt noted that:

- Understanding the perspectives of operators is important to intervene into the supply chain of the communications system.
- The market in Africa is not fully liberalized and operates in the general scarcity situation, however convergence and technological shifts are providing opportunities for intervention in the value chain of telecommunication market.
- The move from vertically integrated monopoly to horizontal regulation will enable NRENs to participate in supply chain of the communication market.

- The regulatory frameworks need to be reviewed to allow National Research and Education Networks to build and operate a strictly non-commercial national network dedicated to a closed user group consisting of research and higher education institutions. This would include access at network level (routing), link level, and physical level (lease/deploy passive optical fibre) and cross-border connections.
- NREN intervention in the communication supply chain will create opportunities for regulatory revision. From the regulatory perspectives, NRENs should be seen as important tools for social and economic development. Regulators should realize that NREN traffic is divided between commercial and research, often the required bandwidth may not be available from the operators.

Discussions that followed the presentations by Bjorn Pehrson and Anders Comstedt focused on the importance of training, content and necessity of building a national backbone infrastructure through public and private partnerships.

Participants underscored the need for training a critical mass of human resources in internetworking technologies and the necessity for retaining skilled network experts.

While content is important it was noted that content development is not generally a major concern. NREN is about content sharing. The moment NREN becomes operational global academic and research content can be available to local universities. NRENs could encourage the development of local content.

The deployment of national backbone using existing operator's network requires trust and agreeable business models between operators. Consolidations may also lead to the organic growth national backbone networks.

4.3.2.5. Experience of the UbuntuNet Alliance

Bjorn Pehrson discussed the UbuntuNet Alliance experience in developing National and Regional Research and Education Networks in Eastern and Southern Africa. The UbuntuNet Alliance is a regional research and education network with a mission to build efficient and affordable bandwidth for their member research and education institutions to participate in global research and networking. The main objectives of the Alliance are to:

- Foster, stimulate and support NRENs development in Eastern and Southern Africa
- Build the UbuntuNet backbone using a staged approach which connects clusters of NRENs by building out from existing cross continental links using the opportunities provided by existing and planned fibre infrastructure projects.

The UbuntuNet has been promoting National Research and Education Networks and supporting the consolidation of NREN activities. Initiatives are also underway to negotiate connectivity to upcoming submarine cables at the eastern and southern African coast.

4.3.2.6. Working Groups

The second day of the workshop was devoted to two working groups that were intended to improve interaction around infrastructure and policy issues among the participants. The first working group focused on the infrastructure for NRENs, the second addressed, policy, readiness and resource mobilization challenges facing academic and research institutions in West and Central Africa.

Infrastructure Working Group

The main recommendations of the Infrastructure Working Group include:

- Sensitization of the policy makers on the importance of National Research and Education Networks (NRENs);
- Realization of existing national backbone networks that link to submarine cable along with electrification and reduction of tariffs of broadband networks;
- Working closely with international development partners and multinational development banks such as the African Development Bank in supporting regional broadband infrastructure development;
- Application of the regional policy harmonization directives and implementation of the initiatives of ECOWAS and ECCAS;
- Promotion of equal access to land-locked countries;
- Promotion of private sector investment in regional fiber infrastructure through enabling policy and regulatory environment;
- Negotiation with satellite service providers through bulk purchase for universities;
- Putting Internet Exchange Points in place;
- Encouraging the availability of universal service funds for implementation of NRENs, and
- Creation of WACREN for negotiating directly with satellite and fiber connectivity providers.

Policy, Regulation and Resource Mobilization Working Group

The main recommendation of the Policy, Regulation, Resource Mobilization and Regional Cooperation Working Group include:

- Improve the awareness of policy makers and regulators about the implication of NREN to development and the communications market;
- Establish an NREN coordinating body at national levels in West and Central African Countries;
- Identify and support champions of NREN at national levels;
- Focus on academic and research peering as a way of improving the understanding of the participation of NRENs in the communications market supply chain;
- Approaching and convincing development partners for internal and external funding;

- Promote leaderships at national and regional levels to build trust for mobilization of resources;
- Improve awareness of policy makers to facilitate the integration of NREN financing in national donor assistance programmes;
- Encourage private sector contribution for the building/donation of infrastructure and purchasing/donation of NREN equipment;
- Develop business models that sustain NRENs through members' contribution.

4.3.2.7. Closing

The Workshop was closed by Mr. Alioune Camara of IDRC who thanked the participants, the consultants for a very interactive deliberation. He indicated that IDRC will continue to support the development of National and Regional Research and Education Network. He encouraged the participants to work closely with their respective ministers to secure their participation at conference in October 2009 and promote the development of NRENs.

4.3.2.8. Recommendation and Way forward

It was evident from the studies that the main challenge to the development of NRENs in Central and West Africa is not lack of the fiber infrastructure but rather inadequate readiness of universities and research institutions to forge collaboration. The challenges are rather organizational and economic. The main challenges are:

- Development of sustainable NRENs and RREN
- Provision of affordable access to links for dedicated RRENs

The development of sustainable NREN and RREN in West and Central Africa requires considerable investment in awareness creation. The following actions need to be taken forward to facilitate awareness creation.

- Organize a conference of Ministers of Higher Education and Information and Communication Technologies to secure high-level political support for NRENs and RRENs. It is recommended that conference of ministers in October 2009 should include a half-day tutorial that discusses demand, infrastructure, policy, regulation, financing relevant to NRENs and RRENs based on international best practices.
- Organize a meeting of university leaders in all countries in West and Central Africa. A high level of support from university leaders is important for sustainable NREN. University leaders are the owners of NRENs, while the ICT departments become customers. All meeting of the university leaders should be accompanied by a half day tutorial discussing demand, infrastructure, policy, regulation, financing based on international best practices.

Building sustainable and successful NRENs in the West and Central African region needs to take the unique circumstances of the countries in the region. This includes improved

availability of experts that speak French and provide coaching on NREN development. Availability of experts that provide on site and off-site support to NRENs is critical to take NRENs off the ground.

It is also important to select a dozen of countries where NREN activities are ripe enough and use these as a showcase to other nations.

All academic and research institutions in Central and West Africa need to be encouraged to put all the building blocks of NRENs in place. These include:

- Getting political endorsement from policy makers
- Building skilled human resources
- Securing Autonomous System Numbers (AS numbers) and address space

Securing affordable access dedicated to NRENs is another prerequisite for successful deployment of NRENs.

The development of Regional Research and Education Network requires further resources for promoting policy and regulatory harmonization through CEMAC, ECOWAS, WATRA, UEMOA and other relevant bodies. A formal creation of WACREN and dialogue with regional and international fiber network providers on securing cheap connectivity to NRENs is also important. The Association of African University needs to continue regional coordination and leadership until such time a fully functional WACREN is established.

The deployment of NREN and RREN is at early stages in West and Central Africa. This implies that resources for their establishment and operation should be available externally at the beginning. The Association of African Universities needs to ensure that the initial resources for formation NRENs and RRENs become available from international development partners.

4.4. High-Level Awareness Conference

4.4.1. Objectives

Purpose of the conference was to present the research reports with key findings to high-level policy and decision-makers in the field of education and ICT (vice-chancellors, ministers in charge of higher education, ministers in charge of ICT and heads of regulatory authorities) in order to sensitise them on the necessity of granting the education and research sector more attention and a particular status in regard to access to bandwidth at lower cost.

The policy and decision-makers, especially ministers, were brought to adopt a declaration advocating for special measures to be taken for research and education networking and affordable access to bandwidth for educational institutions.

4.4.2. Conference report

4.4.2.1. Opening

The Workshop was opened by Mr. Alex Tettey-Enyo, the Minister of Education and Sport on behalf of his Excellency John Dramani Mahama, the Vice President of the Republic of Ghana. The vice president underscored the importance of research and education network for teaching and learning process in tertiary institutions, the progress made in advancing tertiary education in Ghana and the formation of GARNET – the Ghanaian Academic and Research Network. He urged the participants to review the state of connectivity of higher education institutions and come up with practical recommendations that can be implemented by the policy makers.

Welcome address was also made by Prof. John Pancras Ssebuwufu, Acting Secretary General of the Association of African Universities and Mrs. Kathryn Toure, Regional Director, International Development Research Centre (IDRC). The meeting also heard statements from His Excellency François Agbéviadé Galley Minister of Higher Education of Togo and Her Excellency Mme Ndèye Fatou Blodin Diop, Minister of ICT of Senegal, Dr. Rita Bissoonauth, Senior Policy Officer, African Union Commission and Mr. Nnamdi Nwokike Executive Secretary of the West African Telecommunications Regulators Association (WATRA).

The statements highlighted the following:

- Higher education institutions have a major role to play for advancing social development and economic growth. There is also a correlation between research and economic growth; yet this cannot be achieved without connectivity;
- Research and Education Networks (RENs) are important for scientific collaboration and enhancing quality of teaching and learning,
- The incorporation of the West and Central African Research and Education Network (WACREN) provides a stimulus for development of NRENs in the region, and
- Governments, the African Union Commission, IDRC and AAU have committed to the development of National Research and Education Networks (NRENs),

4.4.2.2. Presentation of the National Role of the National Research and Education Network

Dr. Boubakar Barry, the Coordinator of the Research and Education Networking Unit (RENU) of the Association of African Universities presented a paper on the role of Research and Education Network. He noted that African higher education institutions have generally bandwidth less than 10 Mbps, which is shared among tens of thousands of students and staff. In reality, most of African academic institutions have somewhat between 1 and 2 Mbps connectivity. The reason from this is not due to unavailability of bandwidth, but rather due to self-restrictions because of high cost of connectivity and budget constraints. African higher education institutions pay an average of 3,000 US\$ or more per month for 1 Mbps,

where their counterparts in Europe or in the US pay 120 US\$ or even less for same connection. The presentation further indicated that:

- African connectivity lags behind the rest of the world with 3% broadband penetration, 0.2% global bandwidth and 2% Internet Protocol (IP) space and this was largely due to lack of enabling policy and regulatory environment
- Progress was made in improving academic connectivity in recent years but the West and Central Africa has still a digital gap (NREN digital hole)

Dr. Barry mentioned that the AAU has been active in promoting research and education connectivity in West and Central Africa. Five task teams have been setup to address the governance, infrastructure, regulatory, partnerships, capacity and content issues of the West and Central African Research and Education Network (WACREN) following its incorporation in August 2010. He noted that there are opportunities that can be seized by the West and Central African RENs including the growing competition that is expected to bring the cost of connectivity down and willingness of the international donor community to support RENs development. He further noted that raising of awareness and improvement of policy and regulatory dialogue between players, convincing governments and funding agencies of the wisdom of investing in infrastructure and scaling up REN efforts are critical. The Ministers and Permanent Secretaries of Ministries of Education and Ministries of ICT from West and Central Africa that commented on the presentation highlighted the diversity of West and Central African countries and the importance of resource mobilization. Discussions also highlighted that:

- NREN development requires various strategies that can be used simultaneously – awareness, capacity building, infrastructure/connectivity, enabling policies and regulation, commitment to work together and partnerships. The governments and higher education institutions need to enable these processes.
- It is important to move beyond the intentions and develop RENs in the region.

4.4.2.3. Presentation of a Survey of Demand for Connectivity of Higher Education Institutions (HEIs) in the West and Central Africa Region

Mr. Paul Hamilton a consultant who coordinated the demand side study made a presentation on the demand for connectivity for REN in West and Central African Universities. The connectivity survey was conducted during June 2008. A total of 51 Higher Education Institutions (HEIs) in the nine West and Central African countries of Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Liberia, Mali, Mauritania, Nigeria and Senegal participated in the research. The study showed that the 2.2 million staff and students in the region have on average of 0.37 Kbps per head (which is reduced to 0.10 Kbps of raw bandwidth once the exaggerating effect of broadband services is removed). Under current procurement arrangements, HEIs in the region will fall further behind their own estimated bandwidth requirements of about 3Gbps by 2013. Half of the universities are covered by satellite although fiber is currently available to over 95% of the universities. The study also found out that the universities pay around US\$2300 per Mbps/month. The cumulative bandwidth costs to academic institutions in West and Central Africa is US\$30 million.

Two options were recommended for the research and academic institutions to increase their bandwidth to a desirable level: either increase the budget in order to buy more bandwidth, or find ways of negotiating better price to buy more bandwidth with the same budget.

The study argued that it is extremely unlikely that the West and Central African universities will be able to afford to increase their budget to some US\$100 million over the next five years in order to meet the estimated cumulative bandwidth demand. Even within a bandwidth buying consortium negotiating bulk discounts on satellite bandwidth, they would still fall considerably short of the bandwidth they require. For this reason, the option of negotiating for price reduction is preferable.

A panel drawn from the University Vice Chancellors that made comments on the presentation indicated that:

- A clear bandwidth deficit exists in West and Central Africa along with variation from 64 Kbps to 10 Mbps;
- The projected bandwidth in the demand study will not be sufficient for academic institutions in Central and West Africa. African academic and research institutions should strive to obtain bandwidth comparable to their peers in America, Asia and Europe. West and Central African Research and Education institutions require same level of connectivity to their peers (not in Mbps but in Gbps);
- The key bottlenecks such as competition, regulation and cross-border connectivity need to be addressed;
- There is a need for optimization of existing infrastructure at Campus levels;
- NREN is important for broader development dividend, competitiveness in the future, therefore awareness and political will is important;
- The University Vice Chancellors association should play a key role in improving interaction among university leaders and with governments;
- It is important to work closely with the African Union Commission, the Economic Community for West African States, the Economic and Monetary Union for West Africa (UMEOA) and the Economic Community for Central African States to improve the participation of decision makers in NREN activities;
- Financing connectivity remains one of the challenges. There are three main sources of NREN funding namely governments, donors and NREN member contributions should be considered. Experience shows that NRENs need to mix central government and donor funding and membership fees based on circumstances and capacity of the institutions to pay for services;
- Government funding should be provided through one or more ministries, departments or other such bodies responsible for education, science, technology, telecommunications or research;
- Donor funding including support from bi-lateral and multi-lateral development organization, public and private foundations should be solicited to pay for the upfront cost of NREN development. Non Governmental Organizations (NGOs) and private industry are also becoming important source of funding. Government and donor funding is critical in the initial phase of establishing the NREN and acquiring the physical network. After the initial phase, funding is also required to continuously upgrade and extend the physical network and to develop new services;

- Member fees are essential for running and sustaining the NREN. These fees often come in the form of annual contributions or “membership fees” and payments for services such as training and consulting and usually come from the institution’s own budgets. It is therefore essential for tertiary institutions to introduce NREN budget lines in their annual budgets.

4.4.2.4. Presentation of Study on Supply of network for Connecting West and Central Africa to the Global Research and Education Infrastructure

The report on the supply of fiber connectivity in West Africa presented by Bjorn Perhson emphasized the importance of connectivity with research and education networks around the world. Universities are agent of change; they need connectivity to do research and to link to the Internet and carry commodity and research traffic. However, with few exceptions, African universities lack access to the same resources for research and education as their peers on other continents, simply because they are not connected to the global research and higher education infrastructure consisting of high capacity regional networks such as GÉANT in Europe, TEIN in Asia, Red CLARA in South America as well as to INTERNET2 and CANARIE in North America.

The study revealed that there is a substantial amount of fiber that is available to academic institutions in West and Central Africa and more fiber is currently being planned and rolled out. However the policy and regulatory environment is not that conducive enough to facilitate the development of NRENs. The market is still a high price-low volume one and there is limited competition for supply of broadband services. Other major challenges facing academic and research institutions in West and Central Africa pertain to readiness in particular to:

- Ensuring that a continuous supply of competent human resources on internetworking technology and the design and management of National Research and Education Networks.
- Securing assigned numbers from AfriNIC (ASN and IP-address spaces)
- Regional cooperation and coordination in particular the promotion of a West and Central African Research and Education Network (WACREN)

The infrastructure discussion was followed by a presentation from Alcatel Lucent, Main One, Google and NCBC. Alcatel Lucent highlighted the importance of national backbone in order to facilitate REN connectivity and expanding access to rural and underserved areas. The presentation also shared the experience that Alcatel Lucent had in developing a national backbone in Mozambique. Main One indicated they are considering a preferential pricing for the Research and Education Networks. The price of 1 Mbps has already dropped from the original US\$4000 per month to less than US\$1000 and this is expected to drop further over the next two years. The presentation by NCBC underscored the importance of local broadband providers for improving connectivity to the domestic academic and research network in Ghana but also to link neighboring countries. It was stated that NCBC is well positioned as a key enabler in the West African sub-region in particular for the land locked countries. The presentation of Google indicated that its main focus is on building capacities of the universities by providing equipment, training and integration costs. Google strives

towards creating sustainable campus networks. Further discussion on the presentation by the consultants and the private sector indicated that:

- Understanding the perspectives of operators is important to intervene into the supply chain of the communications system,
- Research and education networks should not only have a customer and supplier relationships but also work together as partners in advancing research and education networks.
- The regulatory frameworks need to be reviewed to allow National Research and Education Networks to build and operate a strictly non-commercial national network dedicated to a closed user group consisting of research and higher education institutions.
- Regulations and policies are permissive on paper but need to allow universities to own fibers and operate their networks,
- NREN maturity and readiness is required – this involves optimum campus network, access to IP numbers and Autonomous System Numbers (ASN), scientific demonstration that benefits the society, policies, plans and strategies, Acceptable Use Policies,
- Prices for international bandwidth will drop dramatically with improved connection to submarine link providers (MainOne, SAT3, Glo1, WACS, ACE), special pricing for NREN still need to be negotiated.

4.4.2.5. Presentation of the Experience of National and Regional Research and Education Network

The experience session covered presentations from the UbuntuNet Alliance, GEANT, WACREN and the Feasibility Study for the African Tertiary Institutions Connectivity (FEAST).

Dr. F. F. Tususbira presented UbuntuNet Alliance's experience in developing National and Regional Research and Education Networks in Eastern and Southern Africa. He noted that the UbuntuNet Alliance is a regional research and education network with a mission to build efficient and affordable bandwidth for their member research and education institutions to participate in global research and networking. The main objectives of the Alliance are to:

- Foster, stimulate and support NRENs development in Eastern and Southern Africa
- Build the UbuntuNet backbone using a staged approach which connects clusters of NRENs by building out from existing cross continental links using the opportunities provided by existing and planned fibre infrastructure projects.

The UbuntuNet Alliance has been promoting National Research and Education Networks and supporting the consolidation of NREN activities. It has successfully negotiated for NREN bandwidth with SEACOM.

The UbuntuNet Experience shows that a fulltime Chief Executive Officer (CEO) and effective NREN board are critical for a successful NREN development. The understanding of main power brokers is useful in order to engage policy makers, regulators and

development partners. The challenges to NREN development is the ability to build research and education networks based on a community of interest. NRENs should not be forced but rather be built by a community that wants to come and work together.

The experience of GEANT was presented by Dr. Dany Vandromme of the French National Research and Education Network RENATER. GÉANT is the high-bandwidth, high-performance pan-European communications infrastructure serving Europe's research and education community. DANTE/ GÉANT have been working with NRENs in developed and developing countries to establish connectivity to GÉANT. The Asia pacific, Latin America, Eastern and Southern Africa, and North America are already connected to GÉANT.

Bjorn Pehrson made a presentation of a Feasibility Study for the African connectivity (FEAST). The purpose of FEAST was to prepare a roadmap the EU-Africa partnership and explore the option for deploying backbone networks in Africa for connecting RENs to GÉANT. FEAST findings show that there is enough infrastructure and ready research and education communities. The main challenges include political, awareness about the nature and importance of dedicated research an education networks as well as the necessity and the will to accelerate the transformation of the communication market. FEAST made a proposal to the European Union to support academic and research institutions that are ready to acquire links, build their networks and strengthen their capacity in terms of educated and trained human resources and the applications that demonstrate the return on investment.

A presentation by the West and Central Research and Education Network indicated that WACREN is fully incorporated in Ghana in August 2010 and has established working groups that will be addressing the governance, connectivity, financing and policy and regulatory challenges facing NRENs in the region.

Discussion that followed the international NREN experience highlighted that the need for training a critical mass of human resources in internetworking technologies and the importance of content. NREN is about content sharing. The moment NREN becomes operational global academic and research content can be available to local universities. NRENs should encourage the development of local content.

4.4.2.6. Working Groups

The second day of the workshop was devoted to two working groups that were intended to improve interaction around infrastructure and NREN readiness issues among the participants. The first working group focused on the infrastructure and financing for NRENs, the second addressed the strategies for strengthening RENs including policy, readiness and resource mobilization challenges facing academic and research institutions in West and Central Africa.

Infrastructure Working Group

The Infrastructure and Financing Working Group considered the following questions:

- Which segment of the infrastructure (campus, backbone, international) is constraining NREN development in West and Central Africa?

- What types of commercial conditions are available to RENs? What strategies are needed to be put in place for bringing the broadband prices down?
- What source of funding is available for establishing REN connectivity?
- What are the key policy and regulatory barriers and how can these be addressed?

The Working Group discussions showed that the major infrastructure challenge in West and Central Africa is largely in cross-border connection segments and that of the last mile broadband connectivity to the academic and research institutions. The national backbones are not well developed in some countries; therefore there is a need for a broadband strategy in selected countries. It was highlighted that the current commercial conditions and tariffs are set high and limited preferential pricing is available for academic and research institutions. With regards to financing various models including the use of universal access fund for REN connectivity should be explored. The Working Group on Infrastructure and Financing also outlined the need for:

- Sensitization of the policy makers on the importance of National Research and Education Networks (NRENs),
- Integration of fiber network in the rollout of public utilities such as water and electricity,
- Working closely with international development partners and multinational development banks such as the African Development Bank to secure their support in financing of the regional broadband infrastructure development,
- Encouraging private sector contribution for the building/donation of infrastructure and purchasing/donation of NREN equipment
- Promotion of the regional policy harmonization directives and implementation of the initiatives of ECOWAS and ECCAS.

The Working Group on strengthening NREN

This Working Group discussed the following questions:

- What are the main challenges to NREN development so far and how can these be addressed?
- How can institutional and governance challenges in fledgling RENs will be addressed?
- What are the main human resource and skill challenges in the development of RENs?
- Is financing a problem? What models of financing are recommended to improve NREN development?

The Working Group reported that awareness of policy makers and university leaders and the absence of NREN blueprints and strategies are the major REN readiness constraints in Central and West Africa. The main governance challenge is lack of joined up vision by all stakeholders.

It was argued by the Working Group that university leaders and vice chancellors have a key convening role for establishment of RENs. It is also important to establish an NREN coordinating body and support champions of NREN at national levels. Human resources development is a main problem for NREN development in West and Central Africa. With regards to financing, the working group indicated the need for a better financing model such as the inclusion of NREN financing in the regular budget of the universities. Other recommendations of the Working Group pertaining to the financing of REN include:

- Lobby development partners for securing external funding for RENs,
- Promote leaderships at national and regional levels to build trust for mobilization of resources.

4.4.2.7. Concluding Panel on Connectivity, NREN Development, Financing (representative of private sector, NREN and Donor agencies)

The concluding panel that was drawn from the donor agency, universities, policy makers and the private sector discussed the financing, NREN development and connectivity challenges. The Panelist highlighted the importance of addressing pedagogical deficit and the need for improving connectivity and content. It was also noted that the West and Central African research and education community should seize the opportunity of the presence of submarine cables and landing points to negotiate for preferential pricing and Indefensible Right of Use (IRU) to fiber wavelengths. In addition, it was highlighted that:

- Donor support for WACREN and strengthen NRENs in the two regions is critical to build on the momentum of the political will and availability of fiber for universities and research institutions.
- It is important to scale up REN development in the regions. NREN development should be organic; those who are ready should move ahead while strengthening fledgling nodes,
- Demonstrating success from the beginning is essential, and,
- The integration of NREN financing in national budget will be important to promote their development. The integration of NREN financing in national budget could serve as a yardstick for political will and stimulate external funding.

4.4.2.8. The Accra NREN/RREN Declaration

The Accra REN Declaration was discussed and adopted by the 130 registered participants of the conference. It is appended as annex.

4.4.2.9. Closing

The Workshop was closed by the Permanent Secretary of the Ministry of Education, Government of Ghana, Dr. Pascal Hoba, representing the Association of African Universities and Mr. Alioune Camara representing the International Development Research Center. The closing panelists urged the West and Central African countries to build on the momentum of the political will and improving connectivity and strengthen RENs to advance

the research, education, teaching and learning process that will have direct impact on economic growth and social development.

4.4.2.9. Conclusions and Recommendations

The High Level Conference on Connectivity for West and Central African Higher Education Institutions indicated that the political will for establishing RENs is high. It was evident from the studies that the main challenge to the development of NRENs in two regions is not lack of the fiber infrastructure or willingness but rather inadequate readiness of universities and research institutions to forge collaboration. The challenges are rather organizational, regulatory and economic than access to fiber infrastructure.

Further awareness and discussions are important to build consensus around organizational, regulatory and financing issues at national levels. The following actions need to be taken forward to facilitate a national consensus on NREN development.

- Support the development of NREN strategies and blueprint that cover financing, connectivity, organizational and content issues on a country by country basis. The blue prints can be used as a platform for engaging all the key stakeholders at national levels. National workshops on NREN blueprints should be accompanied by a half-day tutorial discussing demand, infrastructure, policy, regulation, financing based on international best practices.
- Start negotiation with submarine cable providers to secure IRU to wavelengths that can be dedicated to the academic and research institutions in the regions.
- Solicit financing of the initial operational cost of NRENs.

Academic and research institutions in Central and West Africa need to be encouraged to put all the building blocks of NRENs in place. These include building skilled human resources, securing Autonomous Network Numbers (ASN) and address space and building sustainable campus networks.

The conference revealed that the deployment of NRENs and WACREN is at early stages. This implies that resources for their establishment and operation should be available externally at the beginning. A support from international development partners to the AAU is essential to facilitate the development of NRENs in the West and Central Africa regions.

4.4. Publications

In the framework of the project, the AAU REN Unit initiated the publication and dissemination of the following titles:

- “Connectivity of African Higher Education Institutions – Addressing the Demand in West and Central Africa” (report of the connectivity study);
- “Connecting West and Central Africa to the Global Research and Education Network” (report of the fibre infrastructure study);
- High-level Conference on Connectivity of African Higher Education Institutions (conference report).

All these publications are available in both English and French. Downloadable versions will

be available shortly.

5. Project Outputs

The major outputs of the project are listed below:

- 1 methodology development activity for the study on connectivity of West and Central African higher education institutions (conducted online);
- 1 study conducted on the state of connectivity of West and Central African higher education institutions (conducted with researchers of the targeted countries);
- 1 study conducted of available fibre infrastructure in West and Central Africa, and assessment of REN readiness (conducted in collaboration with researchers of the targeted countries);
- 1 preparatory workshop for the conference on connectivity of West and Central African higher education institutions; participants included Permanent Secretaries and Advisers of Ministers in charge of Higher Education and ICT of West and Central Countries;
- 1 High-Level Awareness Conference on Connectivity of West and Central African Higher Education Institutions. The 130+ participants included Ministers, Permanent Secretaries and Advisers of Ministers in charge of Higher Education and ICT of West and Central Countries, Telecommunications Regulators, Representatives of continental, regional and national organizations (African Union Commission, Union Economique et Monétaire Ouest Africain – UEMOA, national ICT agencies), Representatives of Development Partners (IDRC), Representatives of the private sector (Fibre infrastructure owners and network operators), and many other stakeholders;
- 3 disseminated publications in both English and French: one on the connectivity study, one on the fibre infrastructure study and one on the high-level awareness conference (conference report).

6. Project Outcomes

The project allowed to contribute in the emergence of a West and Central African research and education community and to significantly strengthen the relationship between that community and the UbuntuNet Alliance (the regional REN for East and Southern Africa).

Moreover, through activities that have involved close collaborators of Ministers in charge of higher education and ICT of the region, and later on Ministers and Permanent Secretaries of these institutions, the establishment of NRENs and the regional REN for West and Central Africa is now on the agenda of many countries of the region.

The AAU has now received several requests from countries of the region for facilitating their REN establishment process. This has been already done in Cameroon, Senegal and Togo, and policy development workshops are now planned in Mali, Benin and Burkina Faso.

It is worth to mention that following activities in Ghana and Senegal, NRENs have been established in these countries (August 2010 in Ghana and March 2011 in Senegal).

Additionally, the West and Central African Research and Education Network (WACREN) has been incorporated in August 2010, and its first Board elected in March 2011, during a retreat of the WACREN Task Team (established by the AAU).

At this occasion, an agreement was signed with RENATER (the NREN of France), for using a soon to be established senRER-RENATER link for the connection of WACREN member NRENs to GEANT, the pan-European REN.

Lastly, the fact that high-level policy and decision makers have now understood the value of RENs and have committed to support REN development processes in their countries and region can be count as one of the major outcomes of the project.

The pre-conference workshop that aims at briefing close collaborators of Ministers was also very useful in ensuring very high-level participation in the High-Level Awareness Conference.

7. Overall Risk and Recommendations

The major risk that was identified even the project started was the participation of high-level policy and decision makers (Ministers) in the last activity of the project, namely the high-level awareness conference.

The course of the project implementation showed that this was in fact a major risk, as the conference had to be postponed twice due to low responsiveness of the ministry partnering for its organization and late feedback from invited ministers.

However, it must be stressed out that the contacts established during the pre-conference workshop (with close collaborators of ministers) were decisive for the participation of Ministers, Permanent Secretaries, Vice-Chancellors and other policy and decision makers.

It is therefore recommended to adopt a similar approach whenever such an event is planned, especially on a field that is not familiar to this high-level target audience.

Annex: The Accra Research and Education Networking (REN) Declaration

1. We the participants of the High Level Conference on Connectivity of West and Central African Higher Education Institutions met in Accra, Ghana between 18th and 19th October 2010 and discussed the state of National and Regional Research and Education Networks development in our two regions. We were informed about the best practices and the successful efforts in establishing regional and national research and education networks in Southern and Eastern Africa, Europe and North America. We discussed infrastructure, financing and coordination challenges.
2. We thank the Government of Ghana and the Association of African Universities for hosting and organizing this timely high-level conference.
3. We observe that:
 - Research and Education Networks are very important for fostering scientific collaboration between and among tertiary-level educational and research institutions and critical for dissemination of knowledge and facilitation of the teaching and learning process,
 - Regional and National Research and Education Networks are becoming essential pre-requisites for global competitiveness especially for addressing poverty alleviation, economic growth and development challenges,
 - Recent improvement of connectivity in Central and Western Africa, particularly the completion of submarine fiber cable systems and national backbones has created tremendous opportunities for bringing affordable high speed connectivity to research and educational institutions in the region.
 - The majority of the universities and research institutions are generally located in cities which are currently connected by a fibre optic network, which in turn is connected to a submarine cable SAT-3, Main One and Glo1, therefore fiber access may not be the primary challenge in many countries.

On the other hand we are concerned that:

- The Central and West African universities lag far behind their peers in establishing National Research and Education Networks and linking up to global research networks. The slow response to development of NREN has had negative impact on teaching, learning, research and competitiveness of African higher education and research institutions and their young generation in the future.
 - Many Central and Western African countries fall behind in availing the estimated bandwidth requirements for academic and research institutions. In particular, we are alarmed by the fact that while a typical modern university needs a bandwidth in the gigabits per second (Gbps) range, most universities in these regions use less than 3 Mbps for International link, falling far folds behind their peers.
 - Moreover, we are apprehensive of the fact that the cost of connectivity is very high and remains one of the main constraints to NRENs development in the region. The survey that was discussed at this conference shows that in 2008 Central and West African Universities paid about US\$3000 per month for 1 Mbps; this amount is in multiples of what other universities in Europe and North America pay for a similar link. In some cases, connectivity is not even available.
4. We have also examined the progress made in Central and West Africa. We commend the leadership role that was played by the Association of African Universities through its

Research and Education Networking Unit (RENU) for improving connectivity to tertiary institutions in Central and West Africa.

5. We welcome the incorporation of the West and Central African Research and Education Network (WACREN) as a “Private Company Limited by Guarantee” company, with no shares, equivalent to a not for profit association in Ghana. This will pave the way for the creation of an advanced regional network that will facilitate the provision of high bandwidth telecommunications network among participating Member NRENs and connect to international networks such as UbuntuNet Alliance, GEANT and Internet2 to facilitate knowledge creation and sharing at the global level.
6. The conference participants appreciate the efforts made by the International Development Research Center in promoting research and education networks in Central and West Africa. The IDRC was a key partner in promoting similar successful activities in the eastern and southern Africa region. We call on the IDRC to continue to play this key role in particular to support the realization of NRENs in the region and to strengthen WACREN.
7. We resolve that:
 - i) National and Regional Research and Education Networks should be considered as “public good” not only for extending connectivity to researchers, academics and students but also as a tool for innovation, knowledge exchange and for extending the benefits to other public networks. They should be designed based on the principle of open access to those involved in research and education.
 - ii) The West and Central African Universities need high speed connectivity comparable to their peers around the world.
 - iii) Every effort should be made at establishing the building blocks of RENS including technical capacity, campus networks, adequate equipment and organizational and governance frameworks for their smooth operation.
8. We call upon the governments to play the primary role in financing NREN development, facilitating broadband network rollout and creating conducive policy and regulatory environments for affordable connectivity to research and education institutions.
9. We call upon all regulators in the region to support policy and ICT sector reforms that facilitate preferential pricing for research and education institution and to allocate resources to promote NREN connectivity, content and to cover operational costs.
10. We call upon private sector to provide preferential rate for connectivity for academic and research institutions and support the development of National and Regional Research and Education Networks and WACREN.
11. We urge university leaders and ICT managers in the region to work together to improve ICT investment at campus levels and join hands, organize and network with other institutions to support the evolution of National Research and Education Networks.
12. We call upon Multilateral Development Banks, in particular the African Development Bank and the World Bank to extend their support for building NREN and the full operation of WACREN.
13. We call upon the European Union to extend its support given to other regions of the world to the West and Central African region in particular for the connection of WACREN to GEANT.

14. We realize that RENs are built around a community of interest and ongoing human networking. We therefore urge other development partners, research community, regional RENs and the international research community to extend their support to the development of research and education networks in west and central Africa.
15. We request the Association of African Universities to intensify its laudable work for the development of RENs in Africa, especially towards the establishment and strengthening of RENs in West and Central Africa. We request the AAU to facilitate the mobilization of funding and technical assistance in collaboration with government, regional organizations, development partners, research and education networks, foundations and the private sector for the realization of NRENs and successful operation of WACREN.

Accra, 19 October 2010